# EXHIBIT 2

# NEWTON's TELECOM DICTIONARY

The Official Dictionary of Telecommunications
Networking and Internet

**16th and a Half Updated, Expanded and Much Improved Edition**

**NEWTON'S TELECOM DICTIONARY**



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sage to the domain announcing the service's completion), that completion is known as Asynchronous.

**Asynchronous Gateway** A routing device used for dial-up services such as modem communications.

**Asynchronous Mapping** A SONET term. SONET optical fiber transmission systems run at a very high rate of speed, of course. In fact, SONET runs at a minimum of 51.84 Mbps, which is the foundation transmission level known as OC-1 (Optical Carrier Level 1). the OC-1 frame begins as a T-3 electrical signal at 44.736 Mbps. The native format of the incoming signals always is electrical in nature, and originates at various speeds. Examples are 64 Kbps (DS-0), 1.544 Mbps (DS-1 — specifically, T-1), 2.048 Mbps (DS-1 — specifically, E-1), or 44.736 (DS-3 — specifically, T-3). As these incoming signals of various speeds are presented to the SONET facility, they are multiplexed to form a T-3 frame and are converted from the T-3 electrical format to the OC-1 optical format. The OC-1 frames then are mapped into (presented to, accepted by, and fit into) the SONET facility in an asynchronous fashion. While the SONET transmission facility, itself, is highly synchronized, it deals with inputs on an asynchronous (start-stop) fashion. These mappings are defined for clear channel transport of digital signals that meet the standard DSX cross connect requirements, typically DS-1 and DS-3 in most practical applications, although DS-2 is also supported. See also SONET.

**Asynchronous Request** An SCSA term. A request where the client does not wait for completion of the request, but does intend to accept results later. Contrast with synchronous request.

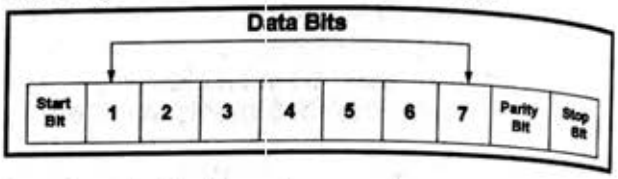
**Asynchronous Teleconferencing** An interactive group communication that allows individuals to communicate as a group without being present together in time or place. Participants to join and exit the conference when it is convenient for them, leaving messages for others and receiving messages left for them. Computer conferencing is an example of asynchronous teleconferencing.

**Asynchronous Terminal** A terminal which uses asynchronous transmissions. See Asynchronous Transmission.

**Asynchronous Time Division Multiplexing** A multiplexing technique in which a transmission capability is organized in a priori unassigned time slots. The time slots are assigned to cells upon request of each application's instantaneous real need.

**Asynchronous Transfer Mode** ATM is the technology selected by the Consultative Committee on International Telephone & Telegraph (CCITT) International standards organization in 1988 (now called the ITU-T) to realize a Broadband Integrated Services Digital Network (B-ISDN). It is a fast, cell-switched technology based on a fixed-length 53-byte cell. All broadband transmissions (whether audio, data, imaging or video) are divided into a series of cells and routed across an ATM network consisting of links connected by ATM switches. Each ATM link comprises a constant stream of ATM cell slots into which transmissions are placed or left idle, if unused. The most significant benefit of ATM is its uniform handling of services, allowing one network to meet the needs of many broadband services. ATM accomplishes this because its cell-switching technology combines the best advantages of both circuit-switching (for constant bit rate services such as voice and image) and packet-switching (for variable bit rate services such as data and full motion video) technologies. The result is the bandwidth guarantee of circuit switching combined with the high efficiency of packet switching. For a longer explanation, see ATM.

**Asynchronous Transmission** Literally, not synchronous. A method of data transmission which allows characters to be sent at irregular intervals by preceding each character with a start bit, and following it with a stop bit. It is the method most small computers (especially PCs) use to communicate with each other and with mainframes today. In every form of data transmission, every letter, number or punctuation mark is transmitted digitally as "ons" or "offs." These characters are also represented as "zeros" and "ones" (See ASCII). The problem in data transmission is to define when the letter, the number or the punctuation mark begins. Without knowing when it begins, the receiving computer or terminal won't be able to figure out what the transmission means.




One way to do this is by using some form of clocking signal. At a precise time, the transmission starts, etc. This is called synchronous transmission. In asynchronous transmission there's no clocking signal. The receiving terminal or computer knows what's what because each letter, number or punctuation mark begins with a start bit and ends with a stop bit. Transmission of data is called synchronous if the exact sending or receiving of each bit is determined before it is transmitted or received. It is called asynchronous if the timing of the transmission is not determined by the timing of a previous character.

Asynchronous is used in lower speed transmission and by less expensive computer transmission systems. Large systems and computer networks typically use more sophisticated methods of transmission, such as synchronous or bisynchronous, because of the large overhead penalty of 20% in asynchronous transmission. This is caused by adding one start bit and one stop bit to an eight bit word — thus 2 bits out of ten.

The second problem with large transfers is error checking. The user sitting in front of his own screen checks his asynchronous transmission by looking at the screen and re-typing his mistakes. This is impractical for transferring long files at high speed if there is not a person in attendance.

In synchronous transmission start and stop bits are not used. According to the book Understanding Data Communications, characters are sent in groups called blocks with special synchronization characters placed at the beginning of the block and within it to ensure that enough 0 to 1 or 1 to 0 transitions occur for the receiver clock to remain accurate. Error checking is done automatically on the entire block. If any errors occur, then the entire block is retransmitted. This technique also carries an overhead penalty (nothing is free), but the overhead is far less than 20% for blocks of more than a few dozen characters.

**AT** 1. Access Tandem.
2. Advanced Technology. Refers to a 16 bit Personal Computer architecture using the 80X86 processor family which formed the basis for the ISA Bus as found in the first IBM PC.
3. AudioTex. See AudioTex.
4. See AT Command Set.

**AT Bus** The electrical channel used by the IBM AT and compatible computers to connect the computer's motherboard and peripheral devices, such as memory boards, video con-

Some beta tests stay in (if they work). Some don't. Most products don't work when they're first introduced. So beta tests are a good idea. Unfortunately, most manufacturers don't do sufficient beta testing. They want to get their product to market before the competition does. This often means we now have two or three new products on the market, none of which work reliably or do exactly what they're meant to do. Our rule: always wait several months after a product is introduced before buying it. By then the major bugs will have been fixed. The test before the beta test is called the Alpha. It isn't that common. See Beta.

**Betacam** Portable camera/recorder system using 1/2-inch tape originally developed by Sony. The name may also refer just to the recorder or the interconnect format; Betacam uses a version of the Y, R-Y, B-Y color difference signal set. Betacam is a registered trademark of the Sony Corporation.

**Betacam SP** A superior performance version of Betacam. SP uses metal particle tape and a wider bandwidth recording system.

**Betamax** 1. The noun. A format for video tape which Sony introduced too expensively. VHS (Video Home System), using half-inch tape introduced by Matsushita/JVC in 1975, effectively killed Sony's attempt to make Betamax the leading video tape standard.

2. The verb. When a technology is overtaken in the market by inferior but better marketed competition as in "Microsoft betamaxed Apple right out of the market." See VHS.

**Betazed** A planet in the second Star Trek TV series, inhabited by Betazoids, beings with great powers of empathy and telepathy.

**BETRS** Basic Exchange Telecommunications Radio Service. A service that can extend telephone service to rural areas by replacing the local loop with radio communications, sharing the UHF and VHF common carrier and private radio frequencies.

**Bezel** The metal or plastic part — in short, the frame — that surrounds a cathode ray tube — a "boob" tube.

**Bezeq** The name of the erstwhile-monopoly Israeli local and long distance phone company. Its full name is the Israel Telecommunications Corp. Ltd.

**BEZS** Bandwidth Efficient Zero Suppression. N.E.T.'s patented T-1 zero suppression technique; maintains Bell specifications for T-1 pulse density without creating errors in end-user data; uses a 32 Kbps overhead channel.

**BFT** Binary File Transfer. BFT is a method of routing digital files using facsimile protocols instead of traditional modem file transfer protocols. See Binary File Transfer for a fuller explanation.

**BFV** Bipolar violations: The digital data format consists of pulses of opposite polarity. No two consecutive pulses should be the same polarity; if two are detected in a row, the term is a violation, which is also a warning flag.

**BGE-I** ISDN Business Group Elements.

**BGID** Business Group ID.

**BGP** Border Gateway Protocol is a Gateway Protocol which routers employ in order to exchange appropriate levels of information. In an intradomain routing environment between Autonomous Systems (ASs), IBGP (Internal BGP) is run, allowing the free exchange of information between trusted systems. IBGP is in a class of protocols known as IGPs, or Internal Gateway Protocols. In an interdomain environment, EBGP (External BGP) is run, allowing the routers to exchange only prespecified information with other prespecified routers in other domains in order to ensure that their integrity is maintained. EBGP is in a class known as EGPs, or External Gateway Protocols. When BGP peer routers first establish contact, they exchange full routing tables; subsequent contacts involve the transmission of changes, only.

**BH** Bandwidth Hog. A term defined by Philip Elmer-DeWitt, technology editor of Time Magazine in 1994, who spearheaded the launch of Time Online, the first fully electronic national magazine. He defined BH "as a person who uses the online medium like a bullhorn and attracts like-minded people who then rove in a pack, filling them with up with screeds." (Screed is a long discourse or essay.)

**BHANG** Broadband High Layer Information: This is a Q.2931 information element that identifies an application (or session layer protocol of an application).

**BHC** Backbone to Horizontal Cross-connect. Point of interconnection between backbone wiring and horizontal wiring.

**BHCA** Busy Hour Call Attempts. A traffic engineering term. The number of call attempts made during the busiest hour of the day.

**BHM** Busy Hour Minutes.

**BHMC** Busy Hour Minutes of Capacity. For Switched Access Service-Feature Groups B and D, this term refers to the maximum amount of access minutes an Interconnector or Interexchange Carrier (IXC) expects to be handled in an End-Office switch at peak activity during any hour between 8 A.M. and 11 P.M.

**Bi** A Latin prefix meaning twice.

**Bi-directional** Antenna that radiates most of its power in two directions.

**BIA** Burned In Address. On most LAN-interface cards (also called NIC or network interface cards), the 48-bit MAC address is burned into ROM - hence the term Burned-In Address. See MAC Address.

**Bias** 1. A systemic deviation of a value from a reference value.

2. The amount by which the average of a set of values departs from a reference value.

3. An electrical, mechanical, magnetic, or other force field applied to a device to establish a reference level to operate the device.

4. Effect on telegraph signals produced by the electrical characteristics of the terminal equipment.

**Bias Distortion** Distortion affecting a two-condition (binary) coding in which all the significant intervals corresponding to one of the two significant conditions have uniformly longer or shorter durations than the corresponding theoretical durations. The magnitude of the distortion is expressed in percent of a perfect unit pulse length.

**Bias Generator** A CBX printed circuit card that generates a signal that reduces idle channel noise for all coders installed in the CBX.

**Bias Potential** The potential impressed on the grid of a vacuum tube to cause it to operate at the desired part of its characteristic curve.

**Bib** Signaling ID assigned by Exchange B.

**BICEP** An ATM term. Bit Interleaved Parity: A method used at the PHY layer to monitor the error performance of the link. A check bit or word is sent in the link overhead covering the previous block or frame. Bit errors in the payload will be detected and may be reported as maintenance information.

**BICI** Broadband Inter-Carrier Interfaces. This is also the Spanish colloquial word for bicycle. See also B-ICI.

**Biconic** Fiber Optic Connector developed by Lucent.

**Biconical Antenna** An antenna consisting of two conical conductors having a common axis and vertex. Excitation occurs at the common vertex. If one of the cones is flattened into a plane, the antenna is called a discone.

in videoconferencing systems, depending on the transmission bandwidth available. Up to about 12 frames a second looks "jerky."
3. One complete cycle of events in time division multiplexing. The frame usually includes a sequence of time slots for the various sub channels as well as extra bits for control, calibration, etc. T-Carrier makes use of such a framing convention for packaging data. Channelized T-1, for instance, frames 24 time slots with a framing bit which precedes each set of sampled data.
4. A unit of data in a Frame Relay environment. The frame includes a payload of variable length, plus header and trailer information specific to the operation of a Frame Relay network service.
5. A metal framework, such as a relay rack, on which equipment is mounted. A distribution frame. A rectangular steel bar framework having "verticals and horizontals" which is used to place semipermanent wire cross connections to permanent equipment. Found in telephone rooms and central offices. See Distribution Frame.

**Frame Alignment** The extent to which the frame of the receiving equipment is correctly phased (synchronized) with respect to that of the received signal.

**Frame Alignment Errors** A frame alignment error occurs when a packet is received but not properly framed (that is, not a multiple of 8 bits).

**Frame Alignment Sequence** See Frame Alignment Signal.

**Frame Alignment Signal** FAS. Frame Alignment Signal or Frame Alignment Sequence.
The distinctive signal inserted in every frame or once in n frames that always occupies the same relative position within the frame and is used to establish and maintain frame alignment, i.e. synchronization. See Frame Alignment Errors.

**Frame Buffer** A section of memory used to store an image to be displayed on screen as well as parts of the image that lie outside the limits of the display. Some systems have frame buffers that will hold several frames, in which case they should be called "frames buffers." But they're not.

**Frame Check Sequence** Bits added to the end of a frame for error detection. Similar to a block check character (BCC). In bit-oriented protocols, a frame check sequence is a 16-bit field added to the end of a frame that contains transmission error-checking information. In a token ring LAN, the FCS is a 32-bit field which follows the data field in every token ring packet. This field contains a value which is calculated by the source computer. The receiving computer performs the same calculation. If the receiving computer's calculation does not match the result sent by the source computer, the packet is judged corrupt and discarded. An FCS calculation is made for each packet. This calculation is done by plugging the numbers (1's and 0's) from three fields in the packet (destination address, source address, and data) into a polynomial equation. The result is a 32-bit number (again 1's and 0's) that can be checked at the destination computer. This corruption detection method is accurate to one packet in 4 billion. See Frame Check Sequence Errors.

**Frame Check Sequence Errors** Errors that occur when a packet is involved in a collision or a corrupted by noise.

**Frame Dropping** The process of dropping video frames to accommodate the transmission speed available.

**Frame Duration** The sum of all the unit time intervals of a frame. The time from the start of one frame until the start of the next frame.

**Frame DS1** The DS1 frame comprises 193 bit positions. The first bit is the frame overhead bit, while the remaining 192 bits are available for data (payload) and are divided into 24 blocks (channels) of 8 bits each.

**Frame Error** An invalid frame identified by the Frame Check Sum (FCS). See also Frame Errors.

**Frame Error Rate** FER. The ratio of errored data frames to the total number of frames transmitted. If the FER gets too high, it might be worth while stepping down to slower baud rate. Otherwise, you would spend more time retransmitting bad frames than getting good ones through. In other words, throughput would suffer. The theory is that the faster the speed of data transmission the more likelihood of error. This is not always so. But if you are getting lots of errors, the first — and easiest — step is to drop the transmission speed. Frame Error Rate is thus a measure of transmission quality. It is generally shown as a negative exponent, (e.g., 10 to the minus 2 power (10^-2) means one out of 100 frames are in error.) The FER is directly related to the Bit Error Rate (BER). See also Bit Error Rate.

**Frame Errors** In the 12-bit, D4 frame word, an error is counted when the 12-bit frame word received does not conform to the standard 12-bit frame word pattern.

**Frame Flag Sequence** The unique bit pattern "01111110" used as the opening and closing delimiter for the link layer frames.

**Frame Frequency** A video term. The number of times per second a frame is scanned.

**Frame Grab** To capture a video frame and temporarily store it for later manipulation by a graphics input device.

**Frame Grabber** A PC board used to capture and digitize a single frame of NTSC video and store it on a hard disk. Also known as Frame Storer. See Video Capture Board.

**Frame Ground** FGD. Frame Ground is connected to the equipment chassis and thus provides a protective ground. Frame Ground is usually connected to an external ground such as the ground pin of an AC power plug.

**Frame Header** Address information required for transmission of a packet across a communications link.

**Frame Length** X.25 packets are fixed in length. ATM cells are fixed in length. Frame Relay frames (packets in the generic sense) are variable in length, which is due to their intended use for LAN internetworking. LAN frames (packets in the generic sense) are variable in length.

**Frame Multiplexing** The process of handling traffic from multiple simultaneous inputs by sending the frames out one at a time in accordance with a specific set of rules. Instead of multiplexing traffic from a lower-speed connection into a higher speed connection based on a specific time duration for each low-speed channel, frame multiplexing using the length of a given frame as the measurement.

**Frame Rate** The number of images displayed per second in a video or animation file. The Frame Rate is highly significant is determining the quality of the image, with a high frame rate creating the illusion of full fluidity of motion. 30 frames per second (30 fps) is considered to be full-motion, broadcast quality. On the other end of the scale, 2fps is most annoying. At 30 fps, the brain processes the images, filling in the blanks due to the "Phi Phenomenon." See PHI Phenomenon.

**Frame Relay** Frame relay, technically speaking, is an access standard defined by the ITU-T in the I.122 recommendation, "Framework for Providing Additional Packet Mode Bearer Services." Frame relay services, as delivered by the telecommunications carriers, employ a form of packet switch-

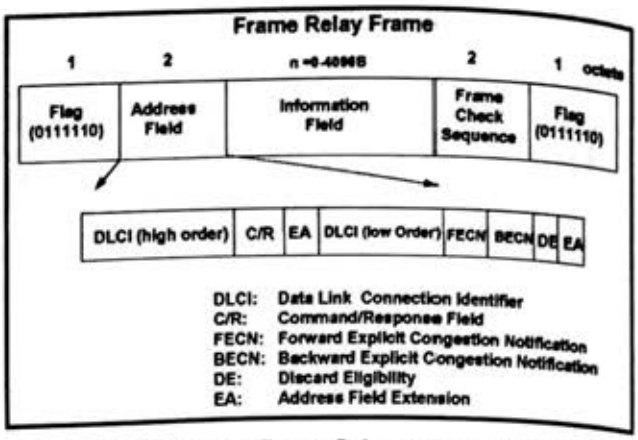
ing analogous to a streamlined version of X.25 networks. The packets are in the form of "frames," which are variable in length, with the payload being anywhere between 0 and 4,096 octets. The key advantage to this approach is that a frame relay network can accommodate data packets of various sizes associated with virtually any native data protocol. In other words, a X.25 packet of 128 bytes or 256 bytes can be switched and transported over the network just as can an Ethernet frame of 1,500 bytes. The native Protocol Data Unit (PDU) is encapsulated in a Frame Relay frame, which involves header and trailer information specific to the operation of the Frame Relay network.

Further, a Frame Relay network is completely protocol independent. Not only can any set of data be accepted, switched and transported across the network, but the specific control data associated with the payload is undisturbed in the process of encapsulation. Additionally, and unlike a X.25 network, a Frame Relay network assumes no responsibility for protocol conversion; rather, such conversions are the responsibility of the user. While this may seem like a step down from X.25, the data neither requires segmentation into fixed length packets nor does the network have to undertake processor-intensive and time-consuming protocol conversion. The yield is faster and less expensive switching.

A Frame Relay network also assumes no responsibility for errors created in the processes of transport and switching. Rather, the user also must accept full responsibility for the detection and correction of such errors. The user also must accept responsibility for the detection of lost packets (frames), as well for the recovery of them through retransmission. Again, this may seem like a step down from X.25 networks, which correct for errors at each network node, and which detect and recover from lost packets. Once again, however, the yield is faster and less expensive switching. In fact, it is unlikely that frames will be damaged, as the switches and transmission facilities are fully digital and offer excellent error performance.

Much like X.25, Frame Relay employs the concept of a shared network. In other words, the network switches accept frames of data, buffer them as required, read the target address and forward them one-by-one as the next transmission link becomes available. In this fashion, the efficiency of transmission bandwidth is maximized, yielding much improved cost of service. The downside is that some level of congestion is ensured during times of peak usage. The level of congestion will vary from time-to-time and frame-to-frame, resulting in latency (delay) which is unpredictable and variable in length. This is especially true in a Frame Relay network (as opposed to X.25), as the length of the frames is variable—the switches never quite know what to expect.

Access to a Frame Relay is over a dedicated, digital circuit which typically is 56/64 Kbps, Nx56/64 Kbps, T-1 or T-3. The device which interfaces the user to the network is in the form of a Frame Relay Access Device (FRAD) which serves to encapsulate the native PDU before presenting it to the network. The FRAD at the destination address unframes the data before presenting it to the target device, with the two FRADs working together much as do PADs in a X.25 environment. Further, it generally is the responsibility of the FRAD to accomplish the error detection and correction process, although this responsibility may be that of the eventual target device. Across the digital local loop, the FRADs connect functionally to Frame Relay Network Devices (FRNDs, pronounced "friends"), proving once again that the carriers want to be your




friends (especially as Frame Relay users tend to be large organizations with lots of $$$ to spend).

Frame Relay is intended for data communications applications, most especially LAN-to-LAN internetworking, which is bursty in nature. Frame Relay is very good at efficiently handling high-speed, bursty data over wide area networks. It offers lower costs and higher performance for those applications in contrast to the traditional point-to-point services (leased lines). Additionally, Frame Relay offers a highly cost-effective alternative to meshed private line networks. As the Frame Relay network is a shared, switched network, there is no need for dedicated private lines, although special-purpose local loops connect each customer location to a frame switch. Transmission of frames between the user sites is on the basis of Permanent Virtual Circuits (PVCs), which are pre-determined paths specifically defined in the Frame Relay routing logic. All frames transmitted between any two sites always follow the same PVC path, ensuring that the frames will not arrive out of sequence. Backup PVCs, generally offered by the carrier at trivial cost, provide redundancy and, therefore, network resiliency in the event of a catastrophic network failure.

With frame relay, a pool of bandwidth is made instantly available to any of the concurrent data sessions sharing the access circuit whenever a burst of data occurs. An addressed frame is sent into the network, which in turn interprets the address and sends the information to its destination over broadband facilities. Those facilities may be as "slow" as 45 Mbps, but more often are SONET fiber optics in nature and operating at much higher speeds. Like traditional X.25 packet networks, frame relay networks use bandwidth only when there is traffic to send.

Frame Relay, while intended for data communications, also supports compressed and packetized voice and video. While such isochronous data is highly sensitive to the variable latency characteristic of packet networks, improved voice compression algorithms such as ACELP provide quite acceptable support for voice over Frame Relay, subject to the level of congestion in the network. For voice to be supported satisfactorily in a packet network, the receiving end compensates for delay and delay variation.

In addition to public network services, Frame Relay can also be implemented in a private network environment consisting of unchannelized T-Carrier circuits. Such an implementation offers exceptional data communications performance over an existing leased line network. Additionally, framed voice and video can ride over such a network, essentially for "free" when the circuits are not being used for data communications purposes. Thereby, the usage of the circuits is maximized, with little concern for poor quality due to network congestion.

A Frame Relay frame consists of a header, information field, and trailer. The header comprises a Flag denoting the begin-

ning of the frame, and an Address Field used for routing of the frame, as well as for purposes of congestion notification. The Information Field is of variable length, from 0 to 4,096 Bytes. The trailer consists of a Frame Check Sequence (FCS) for detection and correction of errors in the Address Field, and an ending Flag denoting the end of the frame.
The American National Standards Institute (ANSI) describes frame relay service in the following documents:
ANSI T1.602 — Telecommunications — ISDN — Data Link Layer Signaling Specification for Application at the User Network Interface.
ANSI T1.606 — Frame Relaying Bearer Service — Architectural Framework and Service Description.
ANSI T1S1/90 - 175 - Addendum to T1.606 - Frame Relaying Bearer Service — Architectural Framework and Service Description.
T1.607-1990 ISDN Layer 3 Signaling Specification for Circuit-Switched Bearer Service for DSS-1
T1.618 DSS-1 Core aspects of Frame Protocol for use with frame relay bearer service, ANSI, 1991
ANSI T1.617a, Signaling specification for Frame Relay bearer service for DSS-1, 1994
Frame relay access makes use of the LAP-D signaling protocol developed for ISDN. Frame relay, technically speaking again, does not address the operation of the network switches, multiplexers or other elements. Both the ITU-T and ANSI were highly active in the development of Frame Relay standards, as was ETSI in Europe. See the next three definitions.

**Frame Relay Access Device** Required for connection into a frame relay network.

**Frame Relay Forum** Organization of frame-relay equipment vendors, carriers, end users and consultants working to speed the development and deployment of frame relay products, as well as interfaces with other broadband technologies, such as ATM. The Frame Relay Forum is based in Foster City, CA. 415-578-6980. It was formed in May 1991 as a non-profit mutual corporation. It has over 300 members. See also Frame Relay Implementors Forum and ATM. www.frforum.com.

**Frame Relay Implementors Forum** A group of companies which have announced their support for a common specification for frame relay connections to link customers premises equipment to networking equipment. The common specification was originally announced on September 4, 1990. The common specification is based on the standard frame relay interface proposed by the American National Standards Institute (ANSI). The common specification supports the proposed ANSI standard and defines the extensions to that standard, including a local management interface that allows the exchange of control information between the user device and the frame relay network equipment. The specification is available for review from Cisco Systems, Digital Equipment Corporation, Northern Telecom and StrataCom. See Frame Relay and Frame Relay Forum.

**Frame Relay Modem** A data communications device which connects to a PC's COM (serial) port and emulates a dial tone while actually establishing a dedicated 56Kbps frame relay connection.

**Frame Slip** That condition in a TDM network under which a receiver of a digital signal experiences starvation or overflow in its receive buffer due to a small difference in the speeds of clocks and the clock (transmission rate) at the transmitter. The receiver will drop or repeat of a full TDM frame (193 bits on a T-1 line) in order to maintain synchronization.

**Frame Store** A system capable of storing complete frames of video information in digital form. This system is used for television standards conversion, computer applications incorporating graphics, video walls and video production and editing systems.

**Frame Switch** A device similar to a bridge that forwards frames based on the frames' layer 2 address. Frame switches are generally of two basic forms, cut-through switch (on-the-fly-switching) or store and forward switch. LAN switches such as Ethernet, Token Ring, and FDDI switches are all examples of frame switches.

**Frame Synchronization** The process whereby a given digital channel (time slot) at the receiving end is aligned with the corresponding channel (time slot) of the transmitting end as it occurs in the received signal. Usually extra bits (frame synchronization bits) are inserted at regular intervals to indicate the beginning of a frame and for use in frame synchronization.

**Frame UNI** Frame-based User-Network Interface, a frame format for access to ATM networks. Defined by the Frame Relay Forum, Frame UNI is a derivative of the DXI standard. For low-speed access application, it provides for a router to send frames (much like Frame Relay frames) to an ATM Edge Switch, where the conversion to cell format takes place.

**Frames** A term used to describe a viewing and layout style of a World Wide Web site, it refers to the simultaneous loading of 2 or more web pages at the same time within the same screen. Originally developed by Netscape and implemented in their Navigator 2.0 browser, today many other popular Web browsers support this feature. Some Web sites come in two versions; a "frames" and "no frames" version. The frames version usually takes a longer to load and may contain other "enhanced" features such as Java and Animation.

**Frames Received OK** The number of frames received without error. See Frames Received Too Long.

**Frames Too Long** An Ethernet statistic that indicates the number of frames that are longer than the maximum length of a proper Ethernet frame, but not as long as frames resulting from jabbering.

**Framework** A Taligent definition. A set of prefabricated software building blocks that programmers can use, extend, or customize for specific computing solutions. With frameworks, software developers don't have to start from scratch each time they write an application. Frameworks are built from a collection of objects, so both the design and code of a framework may be reused.

**Framing** An error control procedure with multiplexed digital channels, such as T-1, where bits are inserted so that the receiver can identify the time slots that are allocated to each subchannel. Framing bits may also carry alarm signals indicating specific alarms. In TDM reception, framing is the process of adjusting the timing of the receiver to coincide with that of the received framing signals. In video reception, the process of adjusting the timing of the receiving to coincide with the received video sync pulse. In facsimile the adjustment of the facsimile picture to a desired position in the direction of line progression.

**Framing Bit** 1. A bit used for frame synchronization purposes. A bit at a specific interval in a bit stream used in determining the beginning or end of a frame. Framing bits are non-information-carrying bits used to make possible the separation of characters in a bit stream into lines, paragraphs, pages, channels etc. Framing in a digital signal is usually repetitive.

**Framing Error** An error occurring when a receiver

tomer's office, home or factory, i.e. "premises" in telephones.
3. In computer software. A loop repeats a series of instructions many times until some prestated event has happened or until some test has been passed.

**Loop Antenna** An antenna consisting of one or more complete turns of wire, both ends of which are to be connected to the input circuit of the radio receiver.

**Loop Back** A diagnostic test in which a signal is transmitted across a medium while the sending device waits for its return. See Loopback and Loopback Test.

**Loop Checking** A method of checking the accuracy of transmission of data in which the received data are returned to the sending end for comparison with the original data.

**Loop Circuit** Generally refers to the circuit connecting the subscriber's set with the local switching equipment.

**Loop Current Detection** When a modem, telephone or fax card (etc.) seizes the line (i.e. completes the connection between tip and ring terminals of the telephone cable) current flows from the positive battery supply in the telephone central office, through the twisted pair in the loop, through the card (or phone) and back to the central office negative terminal where it is detected, showing that this telephone or telephone device is off hook. The fax card or modem can detect problems such as disconnects, shutting down the connection or a busy signal.

**Loop Extender** Device in the central office that supplies augmented voltage out to subscribers who are at considerable distances. It provides satisfactory signaling and speech for such subscribers.

**Loop Plant** Telco-talk for all the wires and hardware and poles and manholes used to connect their central offices to their customers.

**Loop Qualification** Test done by the phone company to make sure the customer is within the maximum distance of 18,000 feet from the central office that services that customer. 18,000 is the maximum distance an ISDN-BRI phone line will work.

**Loop Reverse-battery** A method of signaling over interoffice trunks in which changes associated with battery reversal are used for supervisory states. This technique provides 2-way signaling on 2-wire trunks; however, a trunk can be seized at only one end. It cannot be seized at the office at which battery is applied. It is also called reverse-battery signaling.

**Loop Signaling** A method of signaling over circuit paths that uses the metallic loop formed by the line or trunk conductors and terminating circuits.

**Loop Signaling Systems** Any of three types of signaling which transmit signaling information over the metallic loop formed by the trunk conductors and the terminating equipment bridges.

**Loop Start** LS. You "start" (seize) a phone line or trunk by giving it a supervisory signal. That signal is typically taking your phone off hook. There are two ways you can do that — ground start or loop start. With loop start, you seize a line by bridging through a resistance the tip and ring (both wires) of your telephone line. The Loop Start trunk is the most common type of trunk found in residential installations. The ring lead is connected to -48V and the tip lead is connected to OV (ground). To initiate a call, you form a "loop" ring through the telephone to the tip. Your central office rings a telephone by sending an AC voltage to the ringer within the telephone. When the telephone goes off-hook, the DC loop is formed. The central office detects the loop and the fact that it is drawing DC current and stops sending the ringing voltage. In ground start trunks, ground Starting is a handshaking routine that is performed by the central office and the PBX prior to making a phone call. The central office and the PBX agree to dedicate a path so incoming and outgoing calls cannot conflict, so "glare" cannot occur. See GLARE. Here are two questions that help in understanding:

How does a PBX check to see if a CO Ground Start trunk has been dedicated?

To see if the trunk has been dedicated, the PBX checks to see if the TIP lead is grounded. An undedicated Ground Start Trunk has an open relay between OV (ground) and the TIP lead connected to the PBX. If the trunk has been dedicated the CO will close the relay and ground the TIP lead.

How does a PBX indicate to the CO that it requires the trunk?

A CO ground start trunk is called by the PBX CO Caller circuit. This circuit briefly grounds the ring lead causing DC current to flow. The CO detects the current flow and interprets it as a request for service from the PBX. See also POTS.

**Loop Test** A way of testing a circuit to find a fault in it by completing a loop and sending a signal around that loop. See Loopback.

**Loop Through** A type of phone system wiring that allows phones to connect to one cable in parallel going to the common central switching equipment. The most common type of Loop Through wiring is that which you have in your home. You have one cable with two conductors — a red and a green — winding through your home. Whenever you want to connect a phone, you simply attach it to the red and green conductors. The other way of connecting phones is called HOME RUN. In that system, every phone has its own one, two or three pairs of conductors which wind their lonely way back to the central PBX or key system cabinet. In Loop Through wiring, many phones share one set of cables. In Home Run Cabling, only one phone sits on that line.

**Loop Timing** A way of synchronizing a circuit that works by taking a synchronizing clock signal from incoming digital pulses.

**Loop Up/Loop Down** In T-1, there are generally two loopback types, LLB (line loopback) and TLB or DLB (terminal or DTE loopback). Loop Up refers to activating one of these loop backs, where as Loop Down refers to deactivating one of these loopbacks.

**Loopback** Type of diagnostic test in which the transmitted signal is returned to the sending device after passing through a data communications link or network. This allows a technician (or built-in diagnostic circuit) to compare the returned signal with the transmitted signal and get some sense of what's wrong. Loopbacks are often done by excluding one piece of equipment after another. This allows you to figure out logically what's wrong. (It's called Sherlock Holmes deductive reasoning.) See Loopback Test.

**Loopback Test** A test typically run on a four-wire circuit. You take the two transmit leads and join them to the two receive leads. Then you put a signal around the loop and see what happens. Measuring differences between the sent and the received signal is the essence of a loopback test. See Loopback.

**Looping** Problem encountered in distributed datagram routing in which packets return to a previously visited node.

**Loopstart Circuit** The standard world-wide telephone circuit. For the phone to signal the phone system that it wants to make a call, it applies a DC termination across the phone line. See Loop Start for a longer explanation.

**Loose Tube Buffer** A cable construction in which the optical fiber is placed in a plastic tube having an inner diam-

**MPEG-3** See MPC3
**MPEG-4** See MPEG.
**MPG** Microwave Pulse Generator. A device that generates electrical pulses at microwave frequencies.
**MPI** 1. Multi-Path Interface. Between a transmitter and receiver, the radio wave can take a direct path and one or more reflected paths. The direct radio wave always arrives prior to the reflected waves. If the reflected waves are of sufficient amplitude, they will interfere with the direct wave. The relationship of the amplitude and time delay between the direct and reflected waves create peaks and nulls at the receiver, causing momentary signal fading or loss. In a digital system, this can result in very significant degradation, as the receiver loses signal acquisition and frame synchronization during each fade. The net effect is an increase in the residual bit error rate.
2. Media Platform Interface libraries. Part of Sun Microsystems' XTL Teleservices architecture. MPIs provide a layer of abstraction between details of the system services, applications and providers. The system services include a message passing "server", a data stream multiplexor streams driver, a provider configuration database and a database administration tool.
**MPLS** MultiProtocol Label Switching. An evolving IETF standard intended for Internet application, MPLS grew out of Cisco's proprietary TAG Switching protocol. MPLS is a widely supported method of speeding up IP-based data communication over ATM networks. As IP and ATM come together, the concept is that of "route at the edge and switch in the core." In other words, routers are used at the ingress and egress edges of the network, where their high levels of intelligence can be best used and where their inherent slowness can be tolerated. Switches are used in the core of the network, where they can take advantage of the intelligent routing instructions provided by the routers, and where their inherent speed offers great advantage. MPLS takes this concept to new heights in an IP (Internet Protocol) WAN (Wide Area Network) such as the Internet, much as does Cisco's proprietary Tag Switching in the LAN (Local Area Network) domain. MPLS works like this: As an IP datastream enters the edge of the network, the ingress Label Switch Router (LSR) reads the full address of the first data packet and attaches a small "label" in the packet header, which precedes the packet. The Label Edge Switches (e.g., MPLS-capable ATM switches) in the core of the network examine the much-abbreviated label, and switch the packet with much greater speed than if they were forced to consult programmed routing tables associated with the full IP address. All subsequent packets in a datastream are automatically labeled in this fashion...and very quickly, as they have been anticipated. Further, the MPLS tag can be used to determine the most appropriate route, or Label Switched Path (LSP) for the datastream, in consideration of its nature and its explicit request for a differentiated Grade of Service (GoS). All packets that are forwarded in the same manner are known as a Forwarding Equivalence Class (FEC). MPLS integrates OSI Layer 2 (Data Link Layer) and Layer 3 (Network Layer), with the result being simplified and improved packet data exchange within a complex packet data network such as the Internet. Improvements in packet data exchange are achieved through path selection metrics including destination, available bandwidth, congestion, and error performance. See also ATM, IP and Tag Switching and LTCS.
**MPM** Marketing Product Management.
**MPN** Manufacturer's Part Number.
**MPOA** MultiProtocol Over Asynchronous Transfer Mode. A developing set of architectural specifications defined by the ATM Forum. Working at Layer 3 (Network Layer) MPOA specifies standards for Layer 2 (Link Layer) switching through a Layer 3 router — i.e., switched routing — over an ATM fabric. MPOA allows companies to build scalable, enterprise-wide LAN internetworks that seamlessly interwork ATM with LAN protocols such as Ethernet, Token Ring, FDDI and Fast Ethernet. In effect, MPOA provides for inter-LAN cut-through, for the deployment of a WAN VLAN (Virtual Local Area Network) over an ATM backbone. MPOA accomplishes this by separating the route calculation function from the Network Layer forwarding function. In support of Network Layer packets such as IP and IPX, the edge routers will recognize the beginning of a data transfer and respond with an ATM network destination address. At that point, the router network will establish a cut-through SVC (Switched Virtual Circuit) which will eliminate router-by-router delays, thereby considerably increasing the speed of associated data transfer. This is accomplished by distributing the connection intelligence through the network to the edge devices; the traditional approach involves each router's acting independently on each packet in an effort coordinated by a centralized router, which can become overloaded. MPOA draws on existing standards, including the Layer 2 LANE (Local Area Network Emulation) from the ATM Forum, and the Layer 3 NHRP (Next Hop Resolution Protocol) from the IETF. MPOA also draws on IP extensions such as RSVP (Resource ReSerVation Protocol), which is used in support of isochronous data such as streaming video over IP networks. See the following four definitions. See also Classical IP over ATM, IP, LANE, NHRP, RSVP and VLAN.
**MPOA Client** MPC. An ATM term. A protocol entity that implements the client side of the MPOA architecture. An MPOA client implements the Next Hop Client (NHC) functionality of the Next Hop Resolution Protocol (NHRP). See MPOA.
**MPOA Server** MPS. An ATM term. A protocol entity that implements the server side of the MPOA architecture. An MPOA Server implements Next Hop Server (NHS) functionality of the NHRP. See MPOA.
**MPOA Service Area** An ATM term. The collection of server functions and their clients. A collection of physical devices consisting of an MPOA server plus the set of clients served by that server. See the three definitions above and one below.
**MPOA Target** An ATM term. A set of protocol address, path attributes, (e.g., internetwork layer QoS, other information derivable from received packet) describing the intended destination and its path attributes. See the four definitions immediately above.
**MPOE** Minimum Point Of Entry, pronounced em-poe. Also known as MPOP (Minimum Point Of Presence), as defined by the FCC, and the LLDP (Local Loop Demarcation Point). The MPOE is the main point of physical and logical demarcation between the LEC (Local Exchange Carrier) and the customer premises. Up to the point of the MPOE, the telco is fully responsible for deployment and maintenance of the local loop connection. Beyond the MPOE, the user organization or building owner is responsible for the extension of the connection to the PBX, Centrex telephone sets, etc. In a campus environment comprising multiple buildings, there may be multiple points of demarcation, in which case one is designated by mutual agreement as the MPOE. Here's a working explanation from Ty Osborn, who works for the best CLEC in California (he says), tosborn@email.pacwest.com, "I was first intoduced to MPOE when I had a (telco) tech out on prem (an

based on the OSI model a forum for doing interoperability testing.

**OSN** Operations System Network.

**OSP** 1. Operator Service Provider. A new breed of long distance phone company. It handles operator-assisted calls, in particular Credit Card, Collect, Third Party Billed and Person-to-Person. Phone calls provided by OSP companies are often more expensive than phone calls provided by "normal" long distance companies, i.e. those which have their own long distance networks and which you see advertised on TV. You normally encounter an OSP only when you're making a phone call from a hotel or hospital phone, or privately-owned pay-phone. It's a good idea to ask the operator what the cost of your call will be before you make it.

2. Online Service Provider. A company that provides content only to subscribers of their service. This content is not available to regular Web surfers. The idea was to build subscription and other revenues from a closed knit group of people. The problem with this idea was the Internet came along and no one any longer could afford a team to compete with the Web's exploding and varied content. So, some online service providers dropped their attempt at content altogether. Others severely limited it. But all were forced to offer (and do offer) access to the Internet. As a result the term "online service provider" has virtually become obsolete, to be replaced by the term, Internet Service Provider.

**OSPF** Open Shortest Path First. A link-state routing algorithm that is used to calculate routes based on the number of routers, transmission speed, delays and route cost.

**OSPFIGP** Open Shortest-Path First Internet Gateway Protocol. An experimental replacement for RIP. It addresses some problems of RIP and is based upon principles that have been well-tested in non-internet protocols. Often referred to simply as OSPF. See OSPF.

**OSPR** Optical Shared Protection Ring.

**OSPS** An AT&T word for Operator Services Position System.

**OSS** Operations Support System. Methods and procedures (mechanized or not) which directly support the daily operation of the telecommunications infrastructure. The average LEC (Local Exchange Carrier) has hundreds of OSSs, including automated systems supporting order negotiation, order processing, line assignment, line testing and billing.

**OSS7** Operator Services Signaling System Number 7.

**OSSI** Operations Support System Interface. An element of DOCSIS (Data Over Cable Service Interface Specification), a project intended to develop a set of specifications for high-speed data transfer over cable television systems. At the head-end of the network, the OSSI provides the interface between the cable modem system and the OSSs. The OSSs, according to the OSI (Open Systems Integration) model, provide for the management of faults, performance, configuration, security and accounting. See also DOCSIS and OSI.

**OSTA** The Optical Storage Technology Association. An international trade association dedicated to promoting the use of writeable optical technology for storing computer data and images. With a membership of more than 60, OSTA helps the optical storage industry define practical implementations of standards to assure the compatibility of resulting products. www.osta.org

**OTC** Operating Telephone Company.

**OTDR** Optical Time Domain Reflectometer, a test and measurement device often used to check the accuracy of fusion splices and the location of fiber optic breakers. See GR.196 and Optical Time Domain Reflectometer.

**OTGR** Operations Technology Generic Requirements.

**Other Common Carriers** Providers of long distance telephone service in competition with AT&T. OCCs often (but not always) have lower rates than AT&T. All long distance carriers — including AT&T — are now called interexchange carriers.

**OTIA** NTIA's Office of Telecommunications and Information Applications (OTIA) assists state and local governments, educations and health care entities, libraries, public service agencies, and other groups in effectively using telecommunications and information technologies to better provide public services and advance other national goals. This is accomplished through the administration of the Telecommunications and Information Infrastructure Assistance Program (TIIAP), the Public Telecommunications Facilities Program (PTFP) and the National Endowment for Children's Educational Television (NECET). The Telecommunications and Information Infrastructure Assistance Program promotes the widespread use of advanced telecommunications and information technologies in the public and non-profit sectors. The program provides matching demonstration grants to state and local governments, health care providers, school districts, libraries, social service organizations, public safety services, and other non-profit entities to help them develop information infrastructures and services that are accessible to all citizens, in rural as well as urban areas. The program was specifically created to support the development of the National Information Infrastructure. The Public Telecommunications Facilities Program supports the expansion and improvement of public telecommunications services by providing matching grants for equipment that disseminate noncommercial educational and cultural programs to the American public. The main objective of the program is to extend the delivery of public radio and television to unserved areas of the United States. Under the program's authority, funds are also allocated to support the Pan-Pacific Educational and Cultural Experiments by Satellite (PEACESAT) project. PEACESAT provides satellite-delivered education, medical, and environmental emergency telecommunications to many small-island nations and territories in the Pacific Ocean. The National Endowment For Children's Educational Television supports the creation and production of television programming that enhances the education of children. The program provides matching grants for television productions, which are designed to supplement the current children's educational program offerings and strengthen the fundamental intellectual skills of children. In addition, a ten-member national Advisory Council on Children's Educational Television provides advice to the Secretary of Commerce on funding criteria for the program and other matters pertaining to its administration. See www.ntia.doc.gov/otiahome/otiahome.html

**OTOH** Abbreviation for "On The Other Hand;" commonly used on E-mail and BBSs (Bulletin Board Systems).

**OTS** Operations Technical Support. See also Office Telesystem.

**OUI** Organizationally Unique Identifier: The OUI is a three-octet field in the IEEE 802.1a defined SubNetwork Attachment Point (SNAP) header, identifying an organization which administers the meaning of the following two octet Protocol Identifier (PID) field in the SNAP header. Together they identify a distinct routed or bridged protocol.

**Out-of-Band** A LAN term. It refers to the capacity to deliver information via modem or other asynchronous connection.

**Out-Of-Band Network Management** A method of

managing LAN bridges and routers that uses telephone lines for communications between the network management station and the managed devices. This type of management is normally in addition to the conventional method which uses the LANs and WANs that are being connected by these devices. The principal advantage is that in the event of a system failure (which may take a LAN or a WAN down), a network supervisor can bypass the failed system and use a telephone link to reach a bridge/router to diagnose a network problem. Bridges and routers must have built-in telephone modems for this to work.

**Out-Of-Band Signaling** Signaling that is separated from the channel carrying the information. Also known as NFAS (Non Facilities Associated Signaling). In the cellular domain, it is known as NCAS (Non Callpath Associated Signaling). Out-Of-Band Signaling is non-intrusive, as it is carried over separate facilities or over separate frequency channels or time slots than those used to support the actual information transfer (i.e., the call). Thereby, the signaling and control information does not intrude on the information transfer. SS7 (Signaling System 7) is an example of NFAS. The signaling information includes called number, calling number, and other supervisory signals. See also In-Band Signaling, NCAS, NFAS and SS7.

**Out-Of-Frame** In T-1 transmission, an OOF (Out Of Frame) error occurs when two or more of four consecutive framing bits are in error. When this condition exists for more than 2.5 seconds a RED alarms is sent by OOF detecting unit. Equipment receiving this RED alarm responds with a YELLOW alarm.

**Out-Of-Order Tone** A tone which indicates the phone line is broken.

**Out-Of-Paper Reception** The ability to receive a facsimile transmission into memory when the facsimile machine is out of paper. The facsimile paper will be printed when you put in new paper.

**Out-Of-Service** Or Used. A term used in the secondary telecom equipment business. Equipment taken from service. Can be in any condition. Expected to work and be complete. May not be.

**Out-Tasking** Using a vendor to perform specific network management tasks; as opposed to "outsourcing" where the whole operation is turned over to an outside vendor. See also Outsourcing.

**Outage** Service interrupted.

**Outage Ratio** The sum of all the outage durations divided by the time period of measurement.

**Outdoor Jack Closure** Closures that protect jacks from moisture, dirt and the elements.

**Outgoing Access** A ITU description of the ability of a device in one network to communicate with a device in another network.

**Outgoing Calls Barred** A switch configuration option that blocks call origination attempts. Only incoming calls are allowed.

**Outgoing Line Restriction** The ability of the system to selectively restrict any outgoing line to "incoming only."

**Outgoing Station Restriction** The ability of the system to restrict any given phone from making outside calls.

**Outgoing Trunk** A line or trunk used to make calls.

**Outgoing Trunk Circuit** Used to carry traffic to a connecting (distant) office. depending on the traffic in an individual office. The types of outgoing trunks used will vary depending on the traffic in an individual office.

**Outgoing Trunk Queuing** OTQ. Extensions can dial a busy outgoing trunk group, be automatically placed in a queue and then called back when a trunk in the group is available. This feature allows more efficient use of expensive special lines such as WATS or FX. Instead of having to redial the trunk access code until a line is free, the caller can activate OTQ. See also Off-Hook Queuing.

**Outgoing WATS** An outgoing WATS (OUTWATS) trunk can only be used for outgoing bulk-rate calls from a customer's phone system to a defined geographical area via the dial-up telephone network. Originally WATS lines came in only lines that could receive calls or lines that could make calls. Now, you can buy a WATS line that handles both incoming and outgoing lines. See WATS.

**Outlet** A set of openings containing electrical contacts into which an electrical device can be plugged. See Outlet Telecommunications.

**Outlet Box** A metallic or nonmetallic box mounted within a wall, floor, or ceiling and used to hold telecommunications outlets/connectors or transition devices.

**Outlet Cable** A cable placed in a residential unit extending directly between the telecommunications outlet/connector and the distribution device.

**Outlet Connector** A connecting device in the work area on which horizontal cable terminates.

**Outlet Telecommunications** A single-piece cable termination assembly (typically on the floor or in the wall) and containing one or more modular telecom jacks. Such jacks might be RJ-11, RJ-45, coaxial terminators, etc.

**Outlier** An ATM term. A node whose exclusion from its containing peer group would significantly improve the accuracy and simplicity of the aggregation of the remainder of the peer group topology.

**Outline Font** Font is the design of printed letters, like the ones you see on this page. The first type was produced with raised metal or wooden blocks. Put ink on the blocks. Put paper on the inked blocks. Lift paper off. Bingo you have type on paper. Blocks came in fonts — styles of type, which has neat names like Times Roman, Helvetica, Souvenir, etc. Blocks also came in various sizes — 10 point, 12 point, 14 point, 36 point, etc. "Point" is simply the name for a way of measuring the size of type, like miles measure distance. When computers came along, they simply copied this technique. You picked type and you picked the size. Printers with print cartridges still work this way. They have to. They couldn't simply take one size font and enlarge or contract it because type enlarged or contracted doesn't look "right." Then two men, John Warnock and Martin Newell, said there had to be a better way and they came up with the idea of an outline font, originally called JaM, then Interpress and now PostScript. In PostScript letters and numbers become mathematical formulas for lines, curves and which parts of the character are to be filled with ink and which parts are not. Because they are mathematical, outline fonts are resolution independent. They can be scaled up or down in size in as fine detail as the printer or typesetter is capable of producing. PostScript outline fonts contain "hints" which control how much detail is given up as the type becomes smaller. This makes smaller type faces much more readable than they otherwise would be. Before outline fonts can be printed, they have to be rasterized. This means that a description of which bits to print where on the page has to be generated. And this is one reason printing outline fonts is so consuming of computer power (whether the power is in the computer or in the printer — usually it's in both). But it's also the reason why outline fonts, of which PostScript is the most successful and the most common, look so great.